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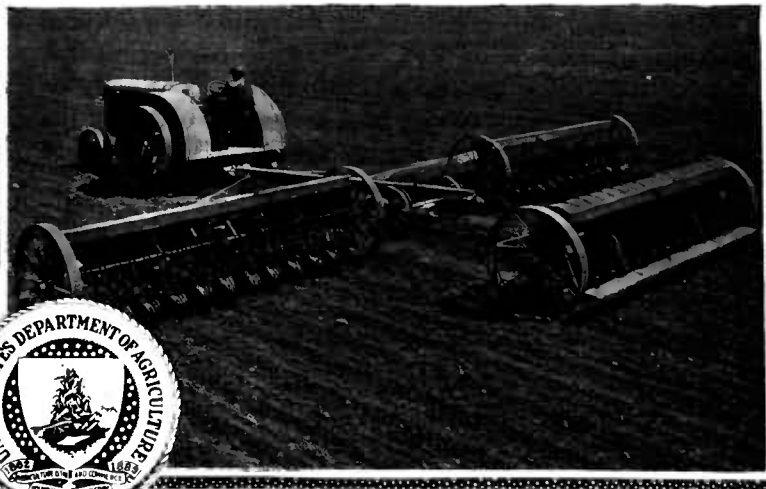
FLAXSEED PRODUCTION BY POWER FARMING METHODS IN THE NORTHERN GREAT PLAINS



FLAX FOR SEED production is well adapted to large-scale farming in parts of northeastern Montana and in the Dakotas where wheat is the principal crop, because it extends the seeding and harvesting periods and therefore makes it possible for the farmer to grow a larger acreage of crops with the same equipment.

With a 3-plow tractor, a combine, and the proper equipment of tillage implements a man can operate about 800 acres where approximately half of the land is fallow and half is cropped to wheat each year. By including flax in the cropping system a somewhat larger acreage can be handled and a better distribution of labor obtained.

A firm, well-settled seed bed is essential for flax. The use of a press drill also is desirable.

Where weeds are numerous it is well to delay seeding until the weed seeds have sprouted and the weeds have been killed by cultivation. Comparatively early seeding of flax, however, is desirable.

The use of the combine is the most economical method of harvesting flax. Clean, well-ripened flax can be harvested by straight combining. Weedy or unevenly ripened flax can be harvested better by the use of the windrower or by allowing the crop to stand until the weeds have been killed by frost.

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FLAXSEED PRODUCTION BY POWER FARMING METHODS IN THE NORTHERN GREAT PLAINS[1]

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PLACE OF FLAX IN THE FARMING SYSTEM

DURING the early agricultural development of the North-Central States flax was grown extensively as a cash crop on new breaking. It was a pioneer crop. Since 1900, however, flaxseed production appears to have become established as a part of the cropping system in the States of Minnesota, North Dakota, South Dakota, and Montana. (Fig. 1.) It is still grown on new land, where this is available, and on lands where tame-grass sod and pastures are broken up for cultivation or reseeding. In the last few years the tractor and the combine have come into general use on the dry-land farms of the Great Plains. These modern implements have made it possible for the individual farmer to handle more land, and as a result the size of farms has increased. Although the tractor, combine, and larger tillage implements have made it possible to increase the acreage handled, there still is the important problem of getting the work done at the proper time. This is especially true of the operations of seeding and harvesting.

Because of the frequent surplus production of wheat in the United States, many farmers in the northern Great Plains are giving more attention to flax as a cash crop. The substitution of flax for a portion of the spring-wheat acreage in areas where flax is well adapted

[1] The results presented in this bulletin are based partly on experimental work conducted by the department of economics and farm management of the Montana Agricultural Experiment Station on the Fairway farm, Brockton, Mont. It is believed that the information will apply to eastern Montana and to the central and western parts of North Dakota and South Dakota. This bulletin treats only of flax grown for its seed, which is quite different from fiber flax. The straw of seed flax does not yield a fiber suitable for spinning.

has an advantage not only from the standpoint of reducing the acreage of the surplus crop but also from the standpoint of farm organization. Low cost of production depends much upon the greatest possible use of equipment. The optimum season for each operation in the preparation and seeding of spring wheat in the northern Great Plains area is very short; consequently on a farm where only wheat is grown the profitable use of equipment is limited to the acreage that can be covered within the proper time limits.

During the five years from 1925 to 1929, inclusive, the average production of flaxseed in the United States was 20,873,000 bushels annually, whereas the total consumption exceeded 43,000,000 bushels annually. The total consumption includes imports of flaxseed and of linseed oil in terms of seed, and also flaxseed used on farms for seeding. Since there has been a shortage of flaxseed and a surplus

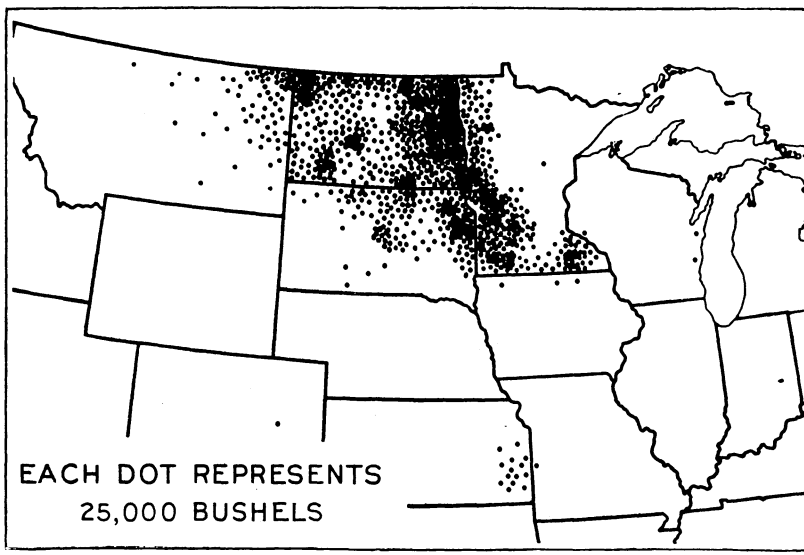

FIGURE 1.—Outline map showing areas of flaxseed production. The principal flaxseed-producing States are North Dakota, Minnesota, South Dakota, and Montana. Large-scale production by power farming methods is practiced most extensively in Montana and the central and western parts of the Dakotas

production of wheat, it is likely that some shift from spring wheat to flax could be made to advantage in the States where both crops are grown.

COMPARATIVE YIELDS OF FLAX AND SPRING WHEAT

In the Dakotas and in Montana the acre yield of flax is roughly half that of spring wheat on the average, although the gross acre value of the two crops is approximately the same. The average acre yields of flax and of spring wheat during the five years from 1924 to 1928 were as follows: North Dakota, 7.2 bushels of flax and 12.2 bushels of wheat; South Dakota, 7.5 bushels of flax and 11.3 bushels of wheat; and Montana, 7.2 bushels of flax and 15.7 bushels of wheat. In 1929 the yields of both crops were markedly lower,

owing to drought, as shown in Table 1. In Minnesota higher acre yields of flax are obtained than in the other States mentioned, and it is generally a more profitable crop than spring wheat.

TABLE 1.—*Average yields and acre values of flax and spring wheat for 1929 and for the 5-year period 1924–1928, based on estimated yield and farm price December 1 in the States named*

State	Year or period	Yield per acre		Value per acre	
		Flax	Wheat	Flax	Wheat
		Bushels	*Bushels*	*Dollars*	*Dollars*
North Dakota	1929	4.7	9.3	13.50	9.60
	1924–1928	7.2	12.2	14.90	13.80
South Dakota	1929	5.9	9.5	16.50	9.40
	1924–1928	7.5	11.3	15.40	13.00
Montana	1929	3.2	9.0	8.95	8.65
	1924–1928	7.2	15.7	14.20	16.80
Minnesota	1929	9.0	13.4	25.80	14.60
	1924–1928	9.7	15.0	20.60	17.65

It will be seen that in the Dakotas the gross acre income from flax has somewhat exceeded that from wheat. In Montana spring wheat has produced a slightly higher gross acre income than flax on the average, but this may be due to the fact that a considerable acreage of spring wheat is grown on fallow land, whereas most of the flax is grown on sod or on spring plowing after wheat. Moreover, flax often is sown too late for best results.

INVESTMENT IN EQUIPMENT

The wheat farmer of the Northwest has more invested in equipment in relation to the number of men employed than has any other farming group. The investment on tractor-operated farms varies from $4,000 to $7,000 per worker. To secure the greatest return on investment the equipment must be used to cover as many acres as possible. At the same time the work must be done well and at just the right season. The production of two crops that have different periods for seeding and harvesting makes it possible to extend the season of these farm operations, thus increasing the acreage that can be handled and reducing the acre cost of operation.

On a farm of one to two sections (640 to 1,280 acres) the investment in machinery generally amounts to about $5 an acre. If a farmer in the northern Great Plains buys a 3-plow tractor and a set of machinery to go with it, he will have about the following implements: One 3-plow tractor, one 3-bottom plow, one 10-foot disk, one 12-foot duck-foot cultivator, one 14-foot drill, and one 10-foot combine. The total cost of this equipment at current prices will be between $3,700 and $4,200. On most farms a truck for hauling the grain to market will be an additional part of the equipment.

The investment per acre, based on a total cost of $4,000 for a minimum full line of equipment, will be as follows:

	Per acre
When 200 acres are farmed	$20.00
When 400 acres are farmed	10.00
When 600 acres are farmed	6.66
When 800 acres are farmed	5.00
When 1,000 acres are farmed	4.00

The investment per acre could be reduced to a much greater extent as far as the amount of work a tractor can do in a season is concerned. However, timeliness of operation determines the number of acres that the equipment can cover economically; therefore, on a farm where wheat is grown exclusively, under the fallow or alternate-crop system, the optimum acreage for a 3-plow tractor is about 800 acres, since seeding and harvesting must be done within very limited periods to obtain the best yields and to prevent loss from shattering.

CROP SEQUENCES THAT EXTEND THE USE OF EQUIPMENT

Economic crop production requires that each farm operation shall be performed at the optimum time. This is especially true in the northern Great Plains, where the moisture supply is limited and the growing season is short. One way in which the capacity of machinery equipment can be increased is to grow two or more crops that do not require the same period for seeding and harvesting. Spring wheat and flax fit into this sort of plan because the optimum seeding date for flax is somewhat later than that for wheat. Moreover, flax is not likely to shatter if it is left standing after ripening. Therefore the harvesting of flax may be put off until after the wheat harvest is completed. As the best season for seeding and harvesting flax follows wheat so satisfactorily, it is possible to extend the use of farm equipment over a longer period. In this manner a greater acreage can be handled without additional investment or increased overhead expense, and therefore the acre cost of producing each crop is reduced. From the standpoint of farm management, the substitution of flax for a part of the acreage otherwise used for wheat is desirable, as both crops can be seeded and harvested at more optimum periods than if only one crop is grown. This should result in higher average yields by having the seeding done at a proper time and by reducing the loss from shattering caused when overripe grain is left standing in the field. Moreover, it reduces the peak of labor required during the rush seasons by extending the seeding and harvesting periods two weeks or more.

In most years the optimum period for seeding spring wheat does not exceed 15 to 20 days. If a longer seeding period is required, the later-sown crop will be at considerable disadvantage owing to the hazard of drought and hot weather at filling time. At the northern Montana substation, Havre, Mont., the average acre yield of wheat seeded medium early (May 1–5) has been 7.3 bushels greater than that seeded 20 days later (May 20–25). The average yields from seeding on three dates during the 6-year period from 1924 to 1929, inclusive, were as follows: April 10–15, 22.3 bushels; May 1–5, 23.8 bushels; and May 20–25, 16.5 bushels per acre.[2] The time for seeding wheat in northern Montana is limited in most seasons to about 20 days; that is, from April 15 to May 5. It is seldom that the soil can be prepared for seeding before the middle of April in that latitude, and the yield of wheat is reduced if seeding is delayed later than the first week in May. Flax, on the other hand, can be sown up to May 25, thus extending the seeding period 15 or 20 days.

[2] Data furnished by M. A. Bell, assistant agronomist in charge of cereal-crop experiments at the Northern Montana Substation, Havre, Mont.

THE WORK SCHEDULE

On dry-land farms in northeastern Montana summer-fallowing is practiced extensively. On an 800-acre farm a 3-plow tractor will furnish the required power if the work scheduled is well planned. On such a farm about 400 acres are fallow each year. As plowing requires more power than disking, many farmers practice a "plowless fallow," in which the soil is cultivated with a 1-way disk or a duck-foot cultivator instead of being plowed. Usually a part of the land is plowed and a part is prepared by the plowless-fallow method. The seasonal work schedule on a tractor-mechanized farm is about as follows:

	Days
Seeding period:	
Cultivation before seeding, 400 acres at 40 acres a day	10
Seeding, 400 acres at 50 acres a day	8
Tractor operation in seeding period	18
Summer-fallow operation:	
First cultivation { 200 acres plowed, at 12 acres a day	17
First cultivation { 200 acres disked, at 40 acres a day	5
Second cultivation, 400 acres at 40 acres a day	10
Third cultivation, 400 acres at 40 acres a day	10
Fourth cultivation, 400 acres at 40 acres a day	10
Tractor operation in summer-fallow operations	52
Harvest period:	
Harvesting with combine, 400 acres at 27 acres a day	15
Total number of days of tractor operation	85

The work schedule as outlined will require 18 days for seeding the crop, 52 days for preparing the fallow land, and 15 days for harvesting, or a total of 85 days of tractor operation.

One problem in the use of the tractor on the farm has been the matter of a proper hitch to the various kinds of machinery to be used. In plowing there usually is little difficulty, but in seeding, harrowing, and cultivating it often is difficult to hook together several units so that the load will be distributed and still permit of easy turning at the corners of the field. The subject of tractor hitches is fully discussed in Montana Agricultural Experiment Station Bulletin 229, entitled "Tractor Hitches."

SOIL PREPARATION

There are different methods of preparing the soil for seeding flax in the northern Great Plains, including spring breaking of sod, spring plowing of wheat stubble, summer-fallow, early summer breaking, and seeding on burned wheat stubble.

SPRING PLOWING AND BREAKING

Where spring plowing of wheat stubble or spring breaking of sod is practiced, the land is worked down to a firm seed bed by the use of the disk and harrow and the seeding is done as soon as possible after plowing. The purpose of the cultivation is to kill weeds and to provide a firm, moist seed bed. For spring breaking sometimes only a heavy roller is used, followed by the drill.

SUMMER-FALLOW

The summer-fallow system, in which a crop is grown every other year, is practiced to some extent in eastern Montana. A more common method is to grow two crops after fallow, that is, fallow every third year. In this case spring wheat is sown after fallow and either wheat or flax is grown the third year. The second crop after fallow often is spoken of as "second-year fallow." Where summer-fallowing is practiced the land should be plowed as early as possible after seeding is completed. Early plowing or disking is very important in order to destroy weeds and conserve the soil moisture supplied by early summer rains. Usually three or four cultivations with duck-foot cultivator, rod weeder, or spring-tooth harrow are required during the summer in order to keep the land free from

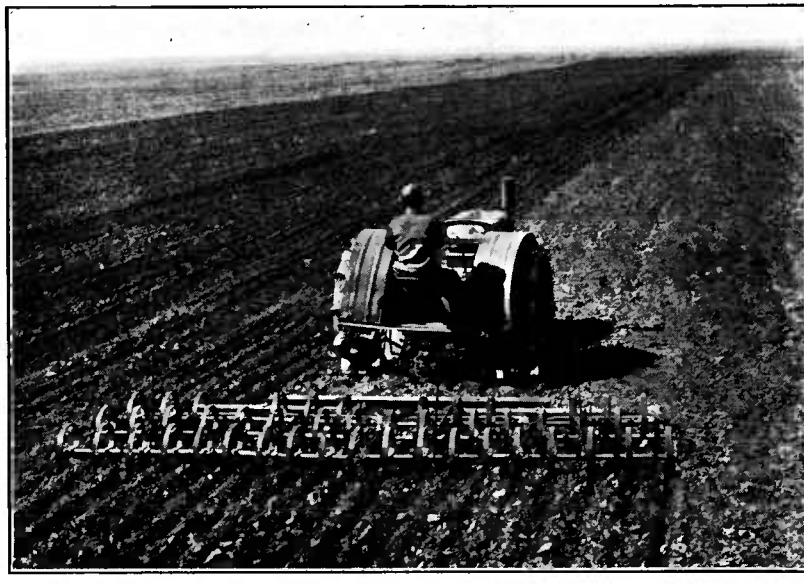

FIGURE 2.—Cultivating summer-fallow with spring-tooth harrow in eastern Montana. This implement kills small weeds and leaves the soil in good condition to take up water readily and prevent run-off from heavy rains

weeds. (Fig. 2.) The duck-foot cultivator is valuable because it ridges the soil and prevents it from blowing. The rotating-rod weeder is very effective in destroying weeds, especially Russian thistles that have made some growth.

SUMMER BREAKING

When sod land is broken in summer it usually can be put in good condition for seeding the following spring. In Montana this is commonly known as "laid-over breaking." In favorable seasons the sod is disked once or twice in the summer to destroy weeds. In dry seasons it may be necessary to omit cultivation until spring, when the sod is disked well, usually by going over it twice with a tandem disk and harrowing before seeding. Summer breaking often produces as good crops as does summer-fallow,

especially if the sod is broken early and kept free from weeds. Figure 3 shows tractor plows breaking sod land in summer in eastern Montana.

FLAX ON BURNED STUBBLE

When a 3-year rotation or summer-fallow, wheat, and flax is practiced, the wheat stubble is burned early in the spring and the land disked at once in preparation for flax. Seeding can be done at once after the stubble is burned and the land disked, or it may be delayed for several days so as to give the land two cultivations. If the stubble is burned early the land may be given two cultivations before seeding, once immediately after burning and again about 10 days later, just before seeding. The second disking kills weeds that may have sprouted after the first cultivation. The burning of

FIGURE 3.—Breaking native sod in early summer in eastern Montana. Summer or "laid-over" breaking is kept free from weeds by disking once or twice in late summer, which puts the sod in shape for seeding the folowing spring. In some cases it is left rough until spring, when it is disked once or twice and harrowed before seeding

stubble followed by disking is a very economical method of soil preparation for flax. Moreover, it is very effective in the control of weeds, especially the Russian thistle. Where the stubble is tall it usually can be burned readily by firing along the windward edge of the field, but where it is thin it may be necessary to use a stubble burner, as shown in Figure 4. Under some conditions it is practically impossible to burn thin stubble completely. In such cases the land may be plowed or disked in preparation for a spring-sown crop, or it may be kept fallow in preparation for a crop the following season.

Because of its possible bad effect on the soil, the writers do not presume to recommend stubble burning as a permanent practice. Although little experimental evidence is available, the experience in some localities indicates that where stubble burning is practiced the soil is more liable to blow than if the stubble is plowed under

and incorporated with the soil. In clay soils the addition of vegetable matter has a beneficial effect, as it tends to prevent puddling, and in sandy soils the stubble helps to prevent blowing by its slight binding effect. On the other hand, the plowing under of a heavy covering of stubble or weeds frequently has an injurious effect on the following crop, especially in dry seasons. Under some conditions stubble burning appears to be justified because of its control of weeds, resulting in better yields of flax, and because of its economy in seed-bed preparation. In years of heavy snowfall the tall stubble holds the snow, which adds to the soil-moisture supply. This may explain why spring-plowed stubble and burned stubble frequently show better results than fall plowing in the northern Great Plains. For further information the reader is referred to Montana Extension Circular 99, entitled "Stubble Burning."

FIGURE 4.—A stubble burner in operation. On thin stubble narrow strips are burned, beginning on the leeward side of the field, so as to insure having a "clean burn"

On the Fairway Farm at Brockton, Mont., where experiments in farm organization and utilization of equipment are being carried on, flax has been grown on a large scale for several years. The crops have been grown under ordinary field conditions such as prevail on most well-tilled farms of Montana. It is of interest to compare the return from flax and spring wheat in 1928, which was a very favorable crop season in that locality, and in 1929, which was an extremely dry year. (Table 2.)

TABLE 2.—*Yields and gross acre values of wheat and flax grown on clean fallow and on burned wheat stubble the second year after fallow, at Fairway Farm, Brockton, Mont., 1928 and 1929*

Crop sequence	Yield per acre		Gross acre value	
	1928	1929	1928	1929
	Bushels	*Bushels*	*Dollars*	*Dollars*
Flax on fallow	20	4	38.00	11.00
Flax on burned stubble	15	4	28.40	11.00
Wheat on fallow	42	14	37.80	13.30
Wheat on burned stubble	29	9	26.10	8.55

On summer-fallow the gross return per acre from flax was approximately the same as from wheat in 1928 but somewhat less than from wheat in 1929. On burned stubble the gross return from flax was $2.30 greater than from wheat in 1928 and $2.45 greater in 1929. In 1928, a favorable season, the yield of flax on the fallow was 20 bushels an acre, as compared with 15 bushels on burned stubble. In 1929, a dry season, the same yields, 4 bushels per acre, were obtained on both summer-fallow and burned stubble. The results obtained in these two seasons of extremely different weather conditions are of interest as indicating the approximate limits of crop yields that may be expected under the best farming practices in that locality.

FIGURE 5.—Disking and seeding burned stubble land to flax in one operation. The use of a press drill is very desirable for seeding flax, as it firms the soil, insuring better germination of the seed

SEED-BED PREPARATION AND SEEDING

A firm seed bed is very essential for flax. The aim of cultivation, therefore, should be to kill all weed growth and still leave the soil in a settled and, if possible, a moist condition so as to insure quick germination. In dry-land farming this condition usually can be provided by disking, seeding, and firming the soil in one operation. Figure 5 shows a tractor drawing a disk and a press drill in seeding flax on burned stubble land. It is important that all weeds should be destroyed by cultivation just before seeding so that the flax will have at least an even start with any freshly sprouting weeds. A loose seed bed should be avoided, as the soil dries out rapidly when in that condition.

The use of a press drill is desirable for seeding flax, especially in the dry-farming area. As this type of drill firms the soil around

the small seeds, it appears to favor quick and uniform germination of the seed. It is desirable to seed flax rather shallow, usually not to exceed 1 inch deep. If the seed is sown too deeply in loose soil the seedling plants can not reach the surface. For this reason a firm, smooth seed bed is desirable. (Fig. 6.)

RATE OF SEEDING

Under conditions of limited rainfall flax is sown at the rate of about 20 pounds to the acre. On breaking, it is a common practice to seed 1 bushel of flax on 3 acres, or at the rate of 19 pounds to the acre. In experiments conducted on old ground at the United States Northern Great Plains Field Station, Mandan, N. Dak., where the annual rainfall averages about 16 inches, the yield of flax sown at

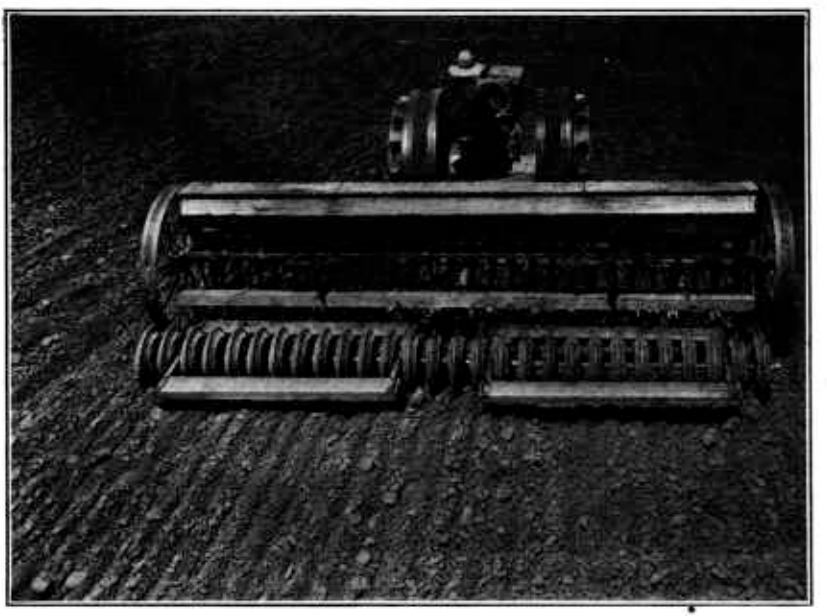

FIGURE 6.—A type of packer with wedge-shaped wheels designed to firm the soil and still leave the surface somewhat ridged to prevent soil blowing. The packer can be attached to any type of drill

the rate of 24 pounds to the acre has been about 20 per cent greater than where the seeding rate was 16 pounds to the acre. A seeding rate of 32 pounds to the acre has produced nearly the same yield as the 24-pound rate. On old land where weeds are prevalent a somewhat heavier rate of seeding is desirable than is required on clean land or breaking. Where the rainfall is greater, as in Minnesota and the eastern half of the Dakotas, a heavier rate of seeding, up to 42 pounds to the acre, is recommended.

DATE OF SEEDING

Flax requires from 90 to 120 days to complete its development from time of seeding to maturity, the time required depending on the character of the growing season, the date of seeding, and the

variety grown. Although good yields sometimes are obtained from flax sown as late as June 15, higher yields on the average are obtained from early seeding. In practice, flax should be sown as early as possible after the seeding of spring wheat is completed. At the United States Northern Great Plains Field Station the best results have been obtained from seeding from May 1 to 20. Lower yields have been obtained from seeding on June 1, and markedly lower yields resulted when seeding was delayed as late as June 10 to 15. On the other hand, there was no advantage from seeding as early as April 15, as occasionally this early sown crop is damaged by freezing in that locality. At the Judith Basin substation, Moccasin, Mont., about the same results have been obtained as at Mandan. As an average of four years' results, flax seeded the first week in May yielded 19.3 bushels, that seeded the third week in May, 15.9 bushels, and that seeded the first week in June, 10.8 bushels per acre. There was a loss, therefore, of 5.1 bushels per acre, or 32 per cent, by delaying seeding from the third week in May to the first week in June. Good yields of flax can be expected if timely rains occur during the filling stage, that is, for 20 to 30 days after blossoming. During that time the oil is formed in the developing seed, and the growth of the seed is practically completed. The process of ripening is largely a matter of dehydration or loss of moisture from the seeds.

VARIETIES OF FLAX

Three wilt-resistant varieties of flax have been introduced in recent years by the North Dakota Agricultural Experiment Station and are now grown very generally in the flax-producing States. These varieties are Linota, Buda, and Bison. The Bison variety is remarkably wilt resistant. It has blue flowers and medium-large brown seeds which usually yield a higher percentage of linseed oil than the small-seeded flaxes. On land where flax has been grown previously one of these varieties is recommended as insurance against loss from flax wilt.

On new lands, where wilt has not been introduced, the so-called Russian flax will give good results. Newland and Reserve are two varieties of this type. N. D. R. No. 52, which is somewhat wilt resistant, is grown widely in western North Dakota and eastern Montana. The large-seeded Argentine flax is grown to a limited extent in some localities. It is more or less resistant to flax wilt, and the plants are practically immune from flax rust. The commercial Argentine seed is not well adapted, however, to the flax-producing area of the United States. The plants generally are short and are not uniform in ripening, especially in wet seasons or if seeded late. In favorable seasons Argentine flax does well, but on the average it has not yielded so well as have the improved varieties (Linota, Buda, and Bison) already mentioned. A selection of Argentine flax named Rio, which was developed by the North Dakota station, is superior to the commercial Argentine flax.

HARVESTING FLAX

Different implements are used for harvesting flax, each designed to produce some economy in the labor required for handling the

crop. In the eastern part of the flax-producing area flax generally is harvested with the binder, and the bundles are placed in shocks to dry before threshing. (Fig. 7.) In the western and drier part

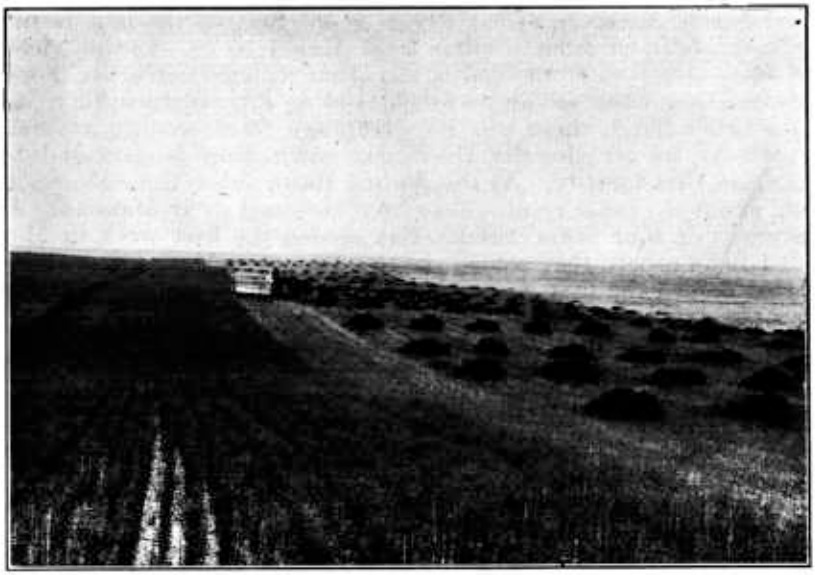

FIGURE 7.—Flax being harvested with the binder and placed in long narrow shocks to dry before threshing

of the flax-producing area the reaper and the header formerly were used extensively. The header is still used in some localities. In harvesting with the header the flax either is dropped in small

FIGURE 8.—Flax being harvested with the header and stacked in narrow ricks to dry before threshing. This method is more economical of labor than harvesting with the binder, but much less economical than with the combine. The header requires a crew of five men and eight horses, as compared with two men and a tractor required to harvest and thresh with the combine

bunches on the ground, where it remains until it is dry enough to thresh directly from the field, or it is stacked from header boxes, as wheat is stacked. (Fig. 8.) In Montana the "header barge"

also is used to some extent. By this method flax that is not fully ripe or that is somewhat weedy is placed in small narrow stacks where it will dry out readily in favorable weather. By use of the header barge flax is harvested with a minimum of labor, the cost of harvesting being about 40 per cent less than when it is stacked from the header box by the usual method. (Fig. 9.) During the last two or three years the modern combine has displaced other methods of harvesting to a large extent.

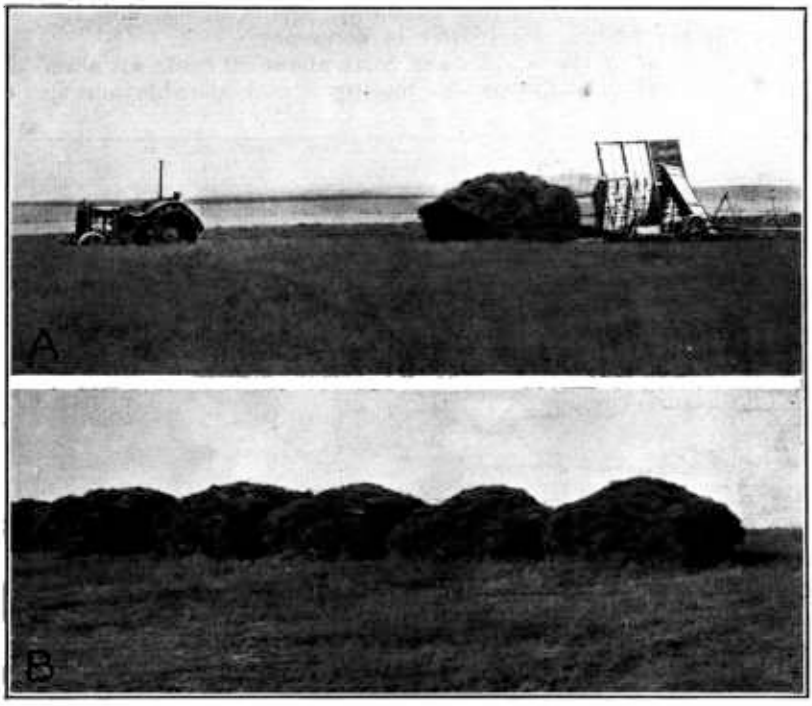

FIGURE 9.—(A) Removing a small stack of flax from the "header barge"; (B) a setting of such stacks. The barge consists of a rigid box with smooth bottom and sides built on a heavy low-wheeled truck. The rear end is constructed of strong poles and is hinged so that it may be lowered when the stack is pulled out

COMBINE HARVESTING

The cost of harvesting flax has been materially reduced by the use of the combine. Three more or less distinct methods of combine harvesting—direct combining, delayed harvesting, and windrowing—can be used, depending upon the condition of the crop.

When the crop is free from weeds and has ripened uniformly, direct combining is the cheapest method and is entirely satisfactory under favorable conditions. The cost of harvesting flax with a combine in eastern Montana has been $2.16 an acre—the average of 60 available records.

If flax is weedy it often is allowed to stand until frost has killed the weeds. Weeds dry up rapidly after being frozen, and the flax crop can be harvested in a few days after frost. Ordinarily flax will stand for a considerable time after ripening without loss from shat-

tering. In very dry hot weather, however, it may shatter somewhat and, therefore, delayed harvesting can be recommended only when late flax does not have to stand too long before frost.

If the flax crop is weedy the use of the windrower is recommended. In dry weather the windrowed flax will be in condition to thresh in three or four days after harvesting. (Fig. 10.) Occasionally there is some difficulty in picking up windrowed flax if it has settled down in Russian thistles. To avoid such difficulties it is desirable to thresh the crop as soon as it is dry. Occasionally the flax crop does not ripen readily because of damp cool weather, and in such seasons the use of the windrower is necessary.

The operation of the windrower costs about 50 cents an acre. In spite of the extra cost, farmers having a considerable acreage to

FIGURE 10.—Threshing flax from the windrow. In heavy stubble the windrow swath is held off the ground, where it dries out rapidly in clear weather

harvest will find it desirable to have some sort of windrower to meet the conditions just described.

Grasshoppers and crickets sometimes cause material losses in flax fields by cutting off the bolls and eating the seeds. Where these insects are present in considerable numbers flax should be harvested and threshed as soon as possible after ripening. The use of the windrower, followed by the combine as soon as the flax is dry, is perhaps the most rapid method of saving the crop from loss. Flax should be threshed as soon as it is sufficiently dry to avoid loss from crickets which are very destructive to flax in the windrow or shock.

ADJUSTMENT OF THE COMBINE

Most makes of combines will thresh flax without any extra attachments, an adjustment of the sieves and air blast usually being all

that is necessary. If the flax is dry when threshed, little trouble will be experienced. In some combines it is desirable to cover a part of the beaters and any shafts where possible in order to prevent the flax stems from winding about these parts.

If flax stems collect on the pegs of the beater, the pegs can be covered by attaching a light 2 by 4 inch scantling in which holes have been bored to fit the pegs. If flax winds on the revolving shafts, they can be covered with gas pipe cut the right length to cover the entire shaft. The gas pipe should fit closely against the shaft bearings for support so as to allow the shaft to revolve freely and without friction within the pipe. These devices can be used on some makes of combines, but not on all kinds. Each combine operator should get instructions from the manufacturer of his machine in regard to proper adjustments for harvesting flax. It is important that flax should be thoroughly ripe and dry when harvested with the combine; threshing when the straw is damp should be avoided if possible. If, however, flax is somewhat tough the cylinder and other moving parts should be run well up to rated speed. If flax is uncommonly dry some seeds may be broken in threshing. This usually can be avoided by lowering the concaves somewhat, or by slowing down the speed of the cylinder. Cylinder teeth out of line also may be the cause of broken grain. Bent cylinder teeth can be straightened and any that are badly worn should be replaced.

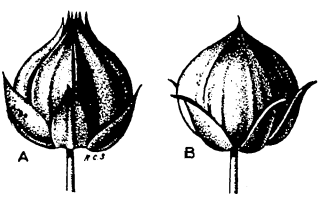

FIGURE 11.—(A) Boll of common flax in which the bolls are semidehiscent when ripe and dry; (B) the same boll when wet by dew or rain. (Twice natural size.) The bolls of some varieties, as the Argentine type of flax, ordinarily remain tightly closed even when fully ripe

MOISTURE CONTENT OF FLAXSEED

In most years the bulk of the flaxseed received at Minneapolis and Duluth, the principal flaxseed markets, contains from 7 to 10 per cent of moisture. In a wet harvest season, such as prevailed in the eastern half of the flax-growing area during the fall of 1926, flax may contain from 9 to 12 per cent of moisture. On the other hand, when ripe flax is harvested and threshed in very dry hot weather the seed may contain as little as 5 to 7 per cent of moisture. It is considered that flax, when free from dockage, is safe for storage if the moisture does not exceed 11 per cent. The Minnesota grades allow not to exceed 11 per cent of moisture in No. 1 and No. 2 flaxseed.

Ripe flax standing in the field is very hygroscopic; that is, it takes up moisture readily in a humid atmosphere and from dew or rain. It is well known that flax is difficult to thresh when damp. When flax is dry enough to thresh readily, the bolls are semidehiscent; that is, they open at the apex and crack slightly along the margins of the five segments of the boll, but close tightly again when wet by dew or rain. Figure 11 shows a boll of common flax in the dry condition (A) and as closed (B) when wet by dew. This character of dehiscence can be used as an indication of the proper condition of flax for harvesting, particularly with the combine. Flax bolls rarely dehisce so far as to allow the seeds to fall out, although this occurs

sometimes in very dry weather, especially if the seeds are shrunken by drought. Observations made in 1928 and 1929 indicate that dehiscence occurs when the seeds contain from 7 to 10 per cent of moisture. In flax dry enough to thresh readily with the combine the bolls are partly open (semidehiscent). This was the condition of flax in numerous fields observed by the writers in 1928 and 1929 where combines were working efficiently. When the flax is tough, as in the morning after dew or after a trace of rain, the bolls are closed. This discussion does not apply to the Argentine type of flax, in which the bolls ordinarily remain tightly closed even when fully ripe.

STORAGE AND MARKETING

As flax threshes much more slowly than wheat, the crop can be hauled to market directly from the combine in the trucks used during the wheat harvest. If flax is hauled directly to market, loss from leakage and from possible wetting in storage is avoided.

As seeds of flax are very small and slippery, they require tight boxes for hauling and tight bins for storage. Wheat frequently is stored in the open without protection from rain, but this will not do for flaxseed. Seeds of flax have a gelatinlike seed coat which absorbs moisture rapidly, and if wet the seeds cake together in a firm mass.

PRODUCTION COSTS

In studies made at the Fairway Farm, Brockton, Mont., it has been found that less than two hours of man labor per acre are required to produce a crop if the land is fallowed one season and a crop is grown the second year. The operation costs, not including land rental, have averaged approximately $7.50 per acre, including cost of summer-fallow and the production of the following crop. When flax has been grown on burned stubble, the time required for tillage, seeding, and harvesting has been only three-fourths of an hour of man labor to the acre, and the total cost of operation has been about $2.50 an acre. In these studies tractor power has been used entirely and the crop has been harvested by a combine.

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